

IN THE CLAIMS

1-137. (Canceled)

138. (Previously Presented) A processing method, comprising:

exposing a first surface of a first substrate to a plasma;

cleaning said first surface after exposure to said plasma;

terminating said first surface with a chemical species after said cleaning step; and

bonding said first surface to a second surface of a second substrate after said

terminating step.

139. (Previously Presented) A method as recited in claim 138, wherein terminating comprises:

immersing said first surface in a solution.

140. (Previously Presented) A method as recited in claim 138, wherein terminating comprises:

immersing said first surface in an N-based solution.

141. (Previously Presented) A method as recited in claim 138, wherein terminating comprises:

immersing said first surface in an ammonia-based solution.

142. (Previously Presented) A method as recited in claim 138, comprising:

performing said exposing, cleaning and terminating steps, in order, on said second surface of said second substrate prior to said bonding step.

143. (Previously Presented) A method as recited in claim 138, comprising:

forming a first bonding layer on said first substrate, and

performing said exposing, cleaning and terminating steps on a third surface of said first bonding layer.

144. (Previously Presented) A method as recited in claim 143, comprising:

forming a second bonding layer on said second substrate, and
performing said exposing, cleaning and terminating steps on a fourth surface of said second bonding layer formed on said second substrate.

145. (Previously Presented) A method as recited in claim 138, wherein said cleaning step comprises removing contaminants from said first surface.

146. (Previously Presented) A method as recited in claim 138, wherein:
said cleaning step comprises a dry process.

147. (Previously Presented) A method as recited in claim 146, wherein:
said terminating step comprises a dry process.

148. (Previously Presented) A method as recited in claim 146, wherein:
said terminating step comprises a wet process.

149. (Previously Presented) A processing method, comprising:
exposing a first surface of a first substrate to a first dry process to at least etch said first surface;

exposing said first surface to a second dry process to at least clean said first surface;
terminating said first surface with a chemical species; and
bonding said first surface to a second surface of a second substrate after said terminating step.

150. (Previously Presented) A method as recited in claim 149, comprising:
performing said exposing, cleaning and terminating steps, in order, on said second surface of said second substrate prior to said bonding step.

151. (Previously Presented) A method as recited in claim 149, comprising:
forming a first bonding layer on said first substrate, and
performing said exposing, cleaning and terminating steps on a third surface of said first bonding layer.

152. (Previously Presented) A method as recited in claim 151, comprising:
forming a second bonding layer on said second substrate, and
performing said exposing, cleaning and terminating steps on a fourth surface of said
second bonding layer formed on said second substrate.

153. (Previously Presented) A method as recited in claim 149, wherein said cleaning
step comprises removing contaminants from said first surface.

154. (Previously Presented) A method as recited in claim 149, comprising:
bonding said first surface to said second surface at about room temperature.

155. (Previously Presented) A method as recited in claim 149, comprising:
obtaining a bond strength at about room temperature sufficient to permit at least one
of grinding and polishing of one of said first and second substrates.

156. (Previously Presented) A method as recited in claim 149, comprising:
obtaining a bond strength of at least about 500 mJ/m^2 at about room temperature.

157. (Previously Presented) A method as recited in claim 149, comprising:
obtaining a bond strength of at least about 1000 mJ/m^2 at about room temperature.

158. (Previously Presented) A method as recited in claim 149, comprising:
obtaining a bond strength of at least about 2000 mJ/m^2 at about room temperature.

159. (Previously Presented) A method as recited in claim 149, wherein:
forming a chemical bond at about room temperature.

160. (Previously Presented) A method as recited in claim 149, wherein:
said second dry process comprises a NH_3 plasma process.

161. (Previously Presented) A method as recited in claim 138, comprising:
bonding said first surface to said second surface at about room temperature.

162. (Previously Presented) A method as recited in claim 138, comprising:

obtaining a bond strength at about room temperature sufficient to permit at least one of grinding and polishing of one of said first and second substrates.

163. (Previously Presented) A method as recited in claim 138, comprising:

obtaining a bond strength of at least about 500 mJ/m^2 at about room temperature.

164. (Previously Presented) A method as recited in claim 138, comprising:

obtaining a bond strength of at least about 1000 mJ/m^2 at about room temperature.

165. (Previously Presented) A method as recited in claim 138, comprising:

obtaining a bond strength of at least about 2000 mJ/m^2 at about room temperature.

166. (Previously Presented) A method as recited in claim 138, wherein:

forming a chemical bond at about room temperature.

167. (Previously Presented) A method as recited in claim 138, wherein said cleaning step comprises cleaning said first surface with an ammonia-based process.

168. (Previously Presented) A processing method, comprising:

exposing a first surface of a first element to a first dry process to at least etch said first surface;

exposing said first surface to a second dry process to at least clean said first surface;

terminating said first surface with a chemical species; and

bonding said first surface to a second surface of a second element after said terminating step.

169. (Previously Presented) A method as recited in claim 168, wherein terminating comprises:

immersing said first surface in a solution.

170. (Previously Presented) A method as recited in claim 168, wherein terminating comprises:

immersing said first surface in an N-based solution.

171. (Previously Presented) A method as recited in claim 168, wherein terminating comprises:

immersing said first surface in an ammonia-based solution.

172. (Previously Presented) A method as recited in claim 168, comprising:
performing said exposing, cleaning and terminating steps, in order, on said second surface prior to said bonding step.

173. (Previously Presented) A method as recited in claim 168, comprising:
forming a first bonding layer on said first element, and
performing said exposing, cleaning and terminating steps on a third surface of said first bonding layer.

174. (Previously Presented) A method as recited in claim 173, comprising:
forming a second bonding layer on said second element, and
performing said exposing, cleaning and terminating steps on a fourth surface of said second bonding layer.

175. (Previously Presented) A method as recited in claim 168, wherein said cleaning step comprises removing contaminants from said first surface.

176. (Previously Presented) A method as recited in claim 168, wherein:
said cleaning step comprises a dry process.

177. (Previously Presented) A method as recited in claim 176, wherein:
said terminating step comprises a dry process.

178. (Previously Presented) A method as recited in claim 176, wherein:
said terminating step comprises a wet process.

179. (Previously Presented) A method as recited in claim 168, comprising:
bonding said first surface to said second surface at about room temperature.

180. (Previously Presented) A method as recited in claim 168, comprising:

obtaining a bond strength at about room temperature sufficient to permit at least one of grinding and polishing of one of said first and second elements.

181. (Previously Presented) A method as recited in claim 168, comprising:
obtaining a bond strength of at least about 500 mJ/m^2 at about room temperature.

182. (Previously Presented) A method as recited in claim 168, comprising:
obtaining a bond strength of at least about 1000 mJ/m^2 at about room temperature.

183. (Previously Presented) A method as recited in claim 168, comprising:
obtaining a bond strength of at least about 2000 mJ/m^2 at about room temperature.

184. (Previously Presented) A method as recited in claim 168, wherein:
forming a chemical bond at about room temperature.

185. (Previously Presented) A method as recited in claim 168, wherein said cleaning step comprises cleaning said first surface with an ammonia-based process.

186. (Previously Presented) A processing method, comprising:
exposing a first surface of a first element to a plasma;
cleaning said first surface after exposure to said plasma;
terminating said first surface with a chemical species after said cleaning step; and
bonding said first surface to a second surface of a second element after said terminating step.

187. (Previously Presented) A method as recited in claim 186, comprising:
performing said exposing, cleaning and terminating steps, in order, on said second surface prior to said bonding step.

188. (Previously Presented) A method as recited in claim 186, comprising:
forming a first bonding layer on said first element, and
performing said exposing, cleaning and terminating steps on a third surface of said first bonding layer.

189. (Previously Presented) A method as recited in claim 188, comprising:
forming a second bonding layer on said second element, and
performing said exposing, cleaning and terminating steps on a fourth surface of said second bonding layer.

190. (Previously Presented) A method as recited in claim 186, wherein said cleaning step comprises removing contaminants from said first surface.

191. (Previously Presented) A method as recited in claim 186, comprising:
bonding said first surface to said second surface at about room temperature.

192. (Previously Presented) A method as recited in claim 186, comprising:
obtaining a bond strength at about room temperature sufficient to permit at least one of grinding and polishing of one of said first and second elements.

193. (Previously Presented) A method as recited in claim 186, comprising:
obtaining a bond strength of at least about 500 mJ/m^2 at about room temperature.

194. (Previously Presented) A method as recited in claim 186, comprising:
obtaining a bond strength of at least about 1000 mJ/m^2 at about room temperature.

195. (Previously Presented) A method as recited in claim 186, comprising:
obtaining a bond strength of at least about 2000 mJ/m^2 at about room temperature.

196. (Previously Presented) A method as recited in claim 186, wherein:
forming a chemical bond at about room temperature.

197. (Previously Presented) A method as recited in claim 186, wherein:
said cleaning step comprises a NH_3 plasma process.

198. (New) A method as recited in claim 186, comprising:
heating said first and second elements to a temperature no more than about 200°C .

199. (New) A method as recited in claim 198, comprising:
obtaining a bond strength of at least about 500 mJ/m^2 .

200. (New) A method as recited in claim 198, comprising:

obtaining a bond strength of at least about 1000 mJ/m².

201. (New) A method as recited in claim 198, comprising:

obtaining a bond strength of at least about 2000 mJ/m².

202. (New) A method as recited in claim 186, comprising:

heating said first and second elements to a temperature in a range about 75-100° C.

203. (New) A method as recited in claim 202, comprising:

obtaining a bond strength of at least about 500 mJ/m².

204. (New) A method as recited in claim 202, comprising:

obtaining a bond strength of at least about 1000 mJ/m².

205. (New) A method as recited in claim 202, comprising:

obtaining a bond strength of at least about 2000 mJ/m².

206. (New) A method as recited in claim 186, comprising:

heating said first and second elements to increase a bond strength between said first and second elements.

207. (New) A method as recited in claim 206, comprising:

obtaining a bond strength of at least about 500 mJ/m².

208. (New) A method as recited in claim 206, comprising:

obtaining a bond strength of at least about 1000 mJ/m².

209. (New) A method as recited in claim 206, comprising:

obtaining a bond strength of at least about 2000 mJ/m².

210. (New) A method as recited in claim 186, wherein:

each of said first and second elements is a substrate.

211. (New) A method as recited in claim 149, comprising:

heating said first and second substrates to a temperature no more than about 200° C.

212. (New) A method as recited in claim 211, comprising:
obtaining a bond strength of at least about 500 mJ/m².
213. (New) A method as recited in claim 211, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
214. (New) A method as recited in claim 211, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
215. (New) A method as recited in claim 149, comprising:
heating said first and second substrates to a temperature in a range about 75-100° C.
216. (New) A method as recited in claim 215, comprising:
obtaining a bond strength of at least about 500 mJ/m².
217. (New) A method as recited in claim 215, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
218. (New) A method as recited in claim 215, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
219. (New) A method as recited in claim 149, comprising:
heating said first and second substrates to enhance a bond strength between said first
and second substrates.
220. (New) A method as recited in claim 219, comprising:
obtaining a bond strength of at least about 500 mJ/m².
221. (New) A method as recited in claim 219, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
222. (New) A method as recited in claim 219, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
223. (New) A method as recited in claim 138, comprising:
heating said first and second substrates to a temperature no more than about 200° C.

224. (New) A method as recited in claim 223, comprising:
obtaining a bond strength of at least about 500 mJ/m².
225. (New) A method as recited in claim 223, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
226. (New) A method as recited in claim 223, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
227. (New) A method as recited in claim 138, comprising:
heating said first and second substrates to a temperature in a range about 75-100° C.
228. (New) A method as recited in claim 227, comprising:
obtaining a bond strength of at least about 500 mJ/m².
229. (New) A method as recited in claim 227, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
230. (New) A method as recited in claim 227, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
231. (New) A method as recited in claim 138, comprising:
heating said first and second substrates to enhance a bond strength between said first
and second substrates.
232. (New) A method as recited in claim 231, comprising:
obtaining a bond strength of at least about 500 mJ/m².
233. (New) A method as recited in claim 231, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
234. (New) A method as recited in claim 231, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
235. (New) A processing method, comprising:
exposing a first surface of a first element to a plasma;

cleaning said first surface after exposure to said plasma;
terminating said first surface with a chemical species; and
bonding said first surface to a second surface of a second element after said
terminating step.

236. (New) A method as recited in claim 235, comprising:
cleaning and terminating in a same step.

237. (New) A method as recited in claim 235, comprising:
forming a first bonding layer on said first element, and
performing said exposing, cleaning and terminating on a surface of said first bonding
layer.

238. (New) A method as recited in claim 237, comprising:
forming a second bonding layer on said second element, and
performing said exposing, cleaning and terminating on a surface of said second
bonding layer.

239. (New) A method as recited in claim 235, wherein said cleaning step comprises
removing contaminants from said first surface.

240. (New) A method as recited in claim 235, wherein:
said cleaning step comprises a dry process.

241. (New) A method as recited in claim 235, wherein:
said terminating step comprises a dry process.

242. (New) A method as recited in claim 235, comprising:
obtaining a bond strength sufficient to permit at least one of grinding and polishing of
one of said first and second elements.

243. (New) A method as recited in claim 235, comprising:
obtaining a bond strength of at least about 500 mJ/m².

244. (New) A method as recited in claim 235, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
245. (New) A method as recited in claim 235, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
246. (New) A method as recited in claim 235, comprising:
forming a chemical bond between said first and second elements.
247. (New) A method as recited in claim 235, comprising:
heating said first and second substrates to a temperature no more than about 200° C.
248. (New) A method as recited in claim 247, comprising:
obtaining a bond strength of at least about 500 mJ/m².
249. (New) A method as recited in claim 247, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
250. (New) A method as recited in claim 247, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
251. (New) A method as recited in claim 235, comprising:
heating said first and second substrates to a temperature in a range about 75-100° C.
252. (New) A method as recited in claim 251, comprising:
obtaining a bond strength of at least about 500 mJ/m².
253. (New) A method as recited in claim 251, comprising:
obtaining a bond strength of at least about 1000 mJ/m².
254. (New) A method as recited in claim 251, comprising:
obtaining a bond strength of at least about 2000 mJ/m².
255. (New) A method as recited in claim 235, comprising:
heating said first and second substrates to enhance a bond strength between said first
and second elements.

256. (New) A method as recited in claim 255, comprising:
obtaining a bond strength of at least about 500 mJ/m^2 .

257. (New) A method as recited in claim 255, comprising:
obtaining a bond strength of at least about 1000 mJ/m^2 .

258. (New) A method as recited in claim 255, comprising:
obtaining a bond strength of at least about 2000 mJ/m^2 .

259. (New) A method as recited in claim 235, wherein:
each of said first and second elements is a substrate.